

## **SAW Three-month Workshop: Mathematical Practices in relation to the Astral Sciences**

The 3-month Workshop “Mathematical Practices in relation to the Astral Sciences” will take place in January - March 2015. It consists of four series of one-day seminars, each dedicated to a specific topic. Most seminars are held on Fridays (one will take place on a Monday) starting at 9:30 and ending about 17:30. They all take place in the [Bâtiment Condorcet](#); maps and directions can be found [here](#).

### **Description**

The second phase of the SAW project will be concluded by a three-month workshop devoted to a description of different mathematical cultures that have been identified in particular in China, the Indian subcontinent and Mesopotamia, mostly in relation to astral science activities. The sessions will be devoted to the reading and discussion of sources.

Information about the texts read for the sessions can be obtained by writing to Karine Chemla ([chemla@univ-paris-diderot.fr](mailto:chemla@univ-paris-diderot.fr)), Agathe Keller ([kellera@univ-paris-diderot.fr](mailto:kellera@univ-paris-diderot.fr)) or Christine Proust ([christine.proust@univ-paris-diderot.fr](mailto:christine.proust@univ-paris-diderot.fr)), depending on whether they deal with China, the Indian subcontinent or Mesopotamia.

### **5 January-13 March 2015**

**organised by:** Karine Chemla (Sphère, CNRS & University Paris Diderot, SAW Project), Matthieu Husson (CNRS, SYRTE, Observatoire de Paris & SAW Project), Agathe Keller (Sphère, CNRS & University Paris Diderot, SAW Project), Christine Proust (Sphère, CNRS & University Paris Diderot, SAW Project) and the SAW group

**Venue: Paris Diderot University, Condorcet Building**  
**4 rue Elsa Morante 75013 Paris or 10 rue Alice Domon et Léonie Duquet 75013**  
**Paris**  
[Map](#)

**9:30 am to 5:30 pm**

## Programme

### Numbers, quantities, measuring units and operations

#### Presentation of the three sessions on this topic

The issues dealt with in the first three days of the workshop relate to those we have explored in the first phase of the SAW Project ([3 month workshop Cultures of Computation and Quantification](#) and [Conference Cultures of computation and Quantification in the ancient world](#)). In the context of their activities in the astral sciences, actors made use of various kinds of numbers and measurement values. In which circumstances did actors opt for one type or another, among the various types of numbers and quantities they used? How can the identification of criteria underlying their choice shed light on the data they recorded in their writings, and their activities with these data (e.g., whether these data were produced by means of measurement or computation, or whether they were meant to enter computation or not, etc.)?

How, also, did actors shape these quantities and measurement values? How did they construct the various measurement units they used in relation to the different activities they carried out? How did they convert between different types of measurement units, different systems? How did actors approximate or interpolate, and how did they shape approximate or simplified procedures, depending on the type of quantities they used? How did issues of precision depend on the measurement values used?

Which operations did actors carry out with the various quantities they used in the context of the astral sciences? How did they write procedures and carry them out?

This first range of questions explores the mathematical cultures that took shape in the context of astral activities from the viewpoint of the quantities put into play and the operations with them. We will also explore the similarities and contrasts that this facet allows us to perceive between these cultures and the mathematical cultures to which other writings testify.

#### 5 January 2015: Numbers versus quantities and sexagesimal place value notation versus decimal notation Room 483 A

##### John Steele (Brown University, USA)

*Description, Calculation, Measurement: Different Uses of Numbers and Quantities in Babylonian Astronomy*

##### Christine Proust (Sphère, CNRS & University Paris Diderot, SAW Project)

*Contrasts and correspondences between different kinds of numbers and quantities: metrological tables from Late Babylonian Nippur and Uruk*

##### Matthieu Husson (CNRS, SYRTE, Observatoire de Paris & SAW Project)

*Remarks on mean motion computations and fixed sexagesimal place value notation (short talk)*

## 16 January 2015: Measurement units and magnitudes Room 483 A

**John Steele (Brown University, USA)**

*Numbers and Units in Babylonian astronomy: The Case of the Rising Time Schemes and the Ziqpu-Star Texts*

**Agathe Keller (Sphère, CNRS & University Paris Diderot, SAW Project)**

*Prthūdaka's commentary on Brahmagupta's rules on operations with sexagesimal numbers or measuring units. (BSS.12.62-65)*

**Karine Chemla (Sphère, CNRS & University Paris Diderot, SAW Project)**

*Various types of numbers, various types of approximations in early Chinese writings on mathematics and astral sciences (short talk)*

## 23 January 2015: Different types of operations Room 483 A

**Karine Chemla & Daniel P. Morgan (Sphère, CNRS & University Paris Diderot, SAW Project)**

*The production of integers and mathematical operations in writings on astral sciences in ancient China*

**Matthieu Husson (CNRS, SYRTE, Observatoire de Paris & SAW Project)**

*Operations on sexagesimal fractions described inside and outside astronomical texts: a comparison*

**Sho Hirose (Sphère, CNRS & University Paris Diderot, SAW Project)**

*Units to measure the arcs of orbits. Bhāskara's commentary on verse 13 of the third chapter of the Āryabhaṭīya*

## Mathematical reasonings in the astral sciences

### Presentation of the three sessions on this topic

Which kind of mathematical reasoning—or rather reasoning involving mathematics—can we restore actors made in the astral sciences? Clearly, some reasonings were geometrical, while other might have been computational. How did actors express these reasonings? When did actors write them down? In which kinds of documents? And, when they did not, can we account for why, and can we restore their reasonings? This range of issues will lead us to deal with the use of the so-called “rules of three,” “Pythagorean theorems,” reasoning in the sphere or in the circle, in the context of the astral sciences. We will, in particular, explore the mathematical reasonings involved in the description of a motion and determination of conjunctions.

**30 January 2015: Reasonings in Sanskrit astronomical texts**  
**Room 646 A**

**Sho Hirose (Sphère, CNRS & University Paris Diderot, SAW Project)**  
*Reasonings in the Goladīpikā of Paramēśvara*

**Agathe Keller (Sphère, CNRS & University Paris Diderot, SAW Project)**  
*Reasonings in Pṛthūdḥaka's commentaries on Brahmagupta*

**Clemency Montelle (University of Canterbury, New Zealand)**  
*Exploring the reasonings of Āmarāja in commentaries on Brahmagupta*

**13 February 2015: Reasonings in Chinese and Latin texts**  
**Room 483 A**

**Karine Chemla (Sphère, CNRS & University Paris Diderot, SAW Project)**  
*Mathematical reasoning in early writings on astral sciences*

**Chen Zhihui (CNRS & University Paris Diderot, SAW Project)**  
*Calculating Ancient Chronology by Ancient Astral-mathematical Methods: Mid-Qing (Late 18th and Early 19th Century) Scholars' Studies on the Chronology of Confucian Classics*

**Matthieu Husson (CNRS, SYRTE, Observatoire de Paris & SAW Project) & Richard Kremer (Dartmouth College, USA)**  
*Conjunction problems in John of Murs's Quadripartitum numerorum and syzygy computations*

**20 February 2015: Reasonings in mathematical and astronomical cuneiform texts**  
**Room 483 A**

**Mathieu Ossendrijver (Humboldt University, Germany)**  
*Mathematical reasoning in the Saros Text (BM 36705+)*

**Christine Proust (Sphère, CNRS & University Paris Diderot, SAW Project)**  
*Rule of three in Late Babylonian mathematical texts: regular / non regular numbers, reciprocals and approximation*

**Pierre Chaigneau (Sphère, CNRS & University Paris Diderot, SAW Project)**  
*Neugebauer's extrapolations from the notation of numbers in astronomical cuneiform texts of the Seleucid period and its consequences (short talk)*

**Motions, Numerical Progressions, Cycles and Remainders**

**Presentation of the two sessions on this topic**

The exploratory workshop suggested the hypothesis that instead of the geometrical ideas imagined by Assyriologists and historians of science to make sense of cuneiform practice in the astral sciences, perhaps the basic tools actors used were numerical progressions. We put forward the hypothesis that tables of numbers displaying arithmetical progressions might have played a key role in the exploration of motion. In fact, these progressions were not purely arithmetical progressions, since motions of astral bodies usually remain in a restricted space. Instead, we would thus have arithmetical progressions with regular changes in the rule of the progression. Arithmetical progressions also seem to have played a key role in the astral sciences in China. Here too, we must speak of progressions between boundaries. This observation invites to consider the question of cycles and remainders together with, and in relation to, that of the type of progressions actors considered. In fact, progressions are a key topic in mathematical texts. Moreover, this topic is closely related to that of unequal sharing. All these remarks suggest, as interesting for our purpose, the question of what actors have done with progressions, and how this could allow us to establish a link between some (parts of) mathematical writings and astral sciences.

These two days of the workshop are devoted to the exploration of the issue of the use of arithmetical progressions in the context of the astral sciences. We could think of several concrete questions: Which is the link between some of the tables used in astral sciences and mathematical work with progressions? How did actors operate with sets of numbers? Which type of numbers do we have in tables, and how does this give clues to inquire into these questions? Answering this question might be important to inquire into the question the relationship between computation and observation—a transversal question important for us. How does the work with progression mesh with the work carried out to determine cycles and operating with remainders?

### 27 February 2015: Arithmetical progressions in the astral sciences Room 483A

**Karine Chemla (Sphère, CNRS & University Paris Diderot, SAW Project) & Li Liang (Institute for the History of Natural Sciences, China)**

*Arithmetic progressions and motions of astral bodies in ancient China*

**Nathan Sidoli (Waseda University, Japan)**

*Approximation techniques to compute the ratio of the epicycle of planets. Selections from Almagest X.6-7*

### 6 March 2015: Zigzag and progression in mathematical and astronomical cuneiform texts Room 483 A

**Christine Proust (Sphère, CNRS & University Paris Diderot, SAW Project)**

*Procedures in Late Babylonian mathematical texts from Uruk: conversions, arithmetical and geometrical progressions*

**Mathieu Ossendrijver (Humboldt University, Germany)**

*Babylonian astronomy and mathematics: two disciplines, one methodology?*

## Instruments

### Presentation of the session on this topic

Mathematical practices attested to in sources on astral sciences often refer to instruments, from the “simple” gnomon to a highly elaborated set of instruments, like the armillary sphere. These instruments could be used for a variety of non mutually exclusive aims, including pedagogical and heuristic purposes, computational purposes, or observations and measures. During this session of the workshop, we will address general questions like: how were instruments used in the practices of astral sciences? Or, what kind of mathematical practices were involved in the conception, the making and uses of instruments? By exploring two distinct corpora we want to describe mathematical practices in relation to astral sciences from the viewpoint of instruments.

### 13 March 2015: Mathematical Practices with Instruments in the Astral Sciences Room 646 A

**Sho Hirose (Sphère, CNRS & University Paris Diderot, SAW Project), Agathe Keller (Sphère, CNRS & University Paris Diderot, SAW Project), Clemency Montelle (University of Canterbury, New Zealand)**

*Comparing a corpus of commentarial texts on Armillary Spheres: Bhāskara, Pṛthūdaka, Āmarāja, Parameśvara*

**Matthieu Husson (CNRS, SYRTE, Observatoire de Paris & SAW Project)**

*John of Lignières’ instruments of the 1322 tables and their comments by John of Saxony*